MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2022/2023

ECE2056 – DATA COMMUNICATIONS AND NETWORKING

(ALL GROUPS)

2 OCTOBER 2023
9:00 a.m – 11:00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 7 pages including cover page with 4 Questions only.
2. Attempt **ALL** Questions. The distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.

Question 1 (25 marks)

(a) Describe the functions of the FIVE (5) layers in the Transmission Control Protocol/Internet Protocol (TCP/IP) model.

[5 marks]

(b) Discuss the advantages of the following concepts in data communication:

(i) Full duplex transmission

[2 marks]

(ii) Byte stuffing

[2 marks]

(iii) Encapsulation process

[2 marks]

(c) Figure Q1(c) shows the source-to-destination data transfer in a virtual-circuit network. Show the corresponding entries in the switching tables of each link.

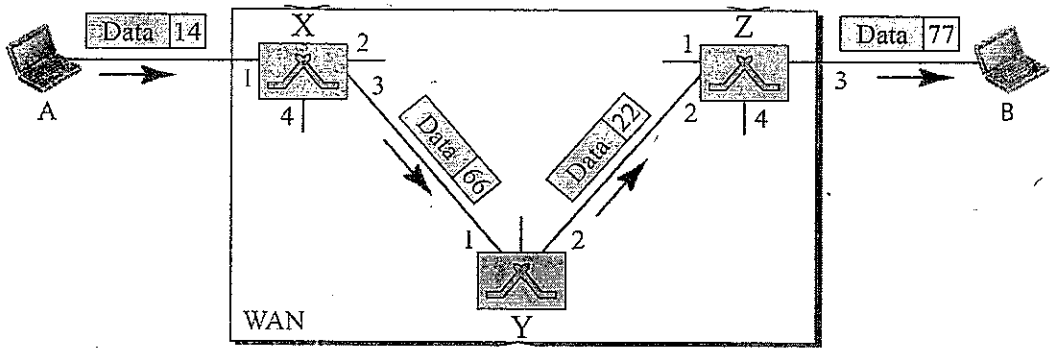

Figure Q1(c)

[6 marks]

Continued...

(d) Figure Q1(d) shows the transmission of Packet 1 with the data-link layer applying the Stop-and-Wait protocol. Packet 1 and Packet 2 are respectively transmitted when Frame 1 and Frame 2 are received successfully.

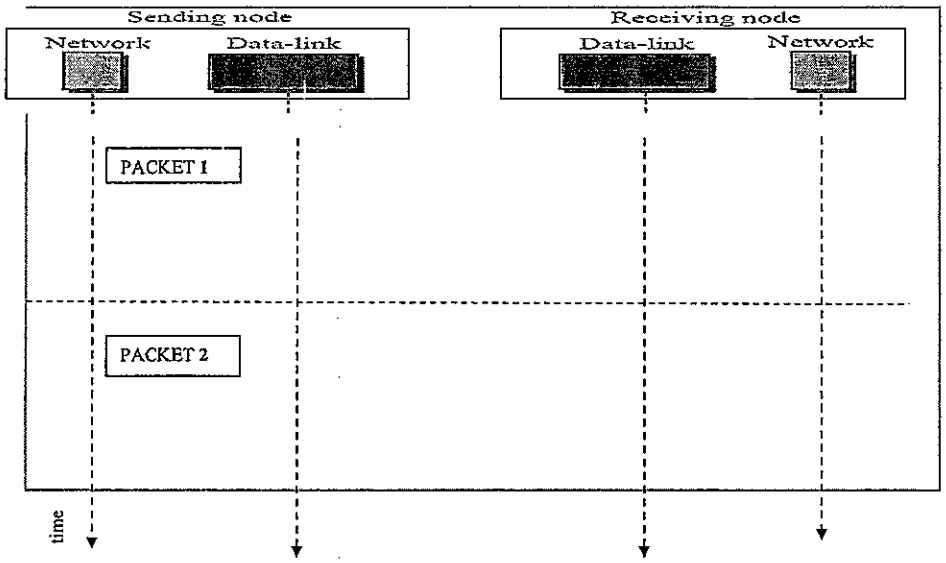

Figure Q1(d)

Redraw Figure Q1(d) and show the flow diagram for the following scenarios:

(i) Frame 1 is sent and lost.

[1 mark]

(ii) Frame 1 is resent and successfully acknowledged.

[2 marks]

(iii) Frame 2 is received and acknowledged, but the acknowledgement is lost.

[2 marks]

(iv) Frame 2 is resent and acknowledged.

[2 marks]

(v) Discuss ONE(1) reason why frames are lost during transmission.

[1 mark]

Continued...

Question 2 (25 marks)

(a) (i) Define random access and list three protocols in this category. [3 marks]

(ii) Briefly explain why the collision detection mechanism can be deployed on wired networks but not on a wireless network. What mechanism is used to address collision in a random access wireless networks? [5 marks]

(iii) In recent years, the IEEE 802.11 WiFi standards have evolved to achieve higher throughputs in the Gigabit range. List THREE(3) related physical layer improvements made. [3 marks]

(b) A carrier-sense multiple access with collision detection (CSMA/CD) network with four stations is shown in Figure Q2(b). The data rate is 10 Mbps, the distance between stations A and C is 2000 m, the distance between stations C and D is 500 m, and the signal propagation speed is 2×10^8 m/s.

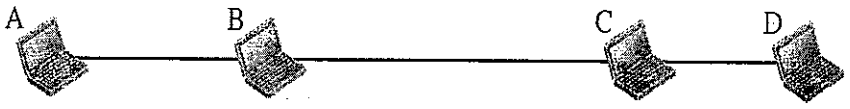

Figure Q2(b)

Station A start sending a frame at time $t_1 = 0$; station C starts sending a frame at $t_2 = 2$ μs. Determine the following:

(i) Minimum frame size required to guarantee collision detection by all stations. [2 marks]

(ii) The time when station C detects the collision. [2 marks]

(iii) The time when station A detects the collision. [2 marks]

(iv) The number of bits station A has sent before detecting the collision. [1 mark]

(v) The number of bits station C has sent before detecting the collision. [1 mark]

(c) (i) Name the type of Ethernet shown in Figure Q2(c). [1 mark]

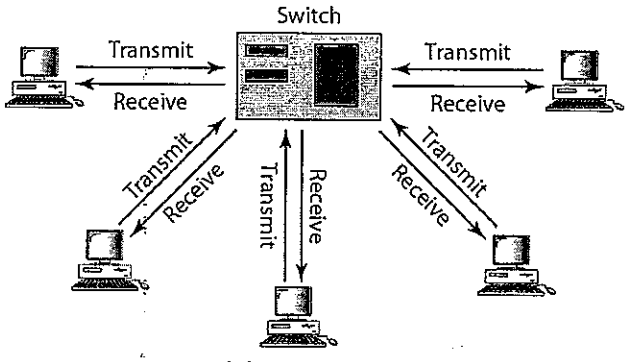

Figure Q2(c)

(ii) Is there a need to use CSMA/CD in the network shown in Figure Q2(c)? Justify your answer. [2 marks]

Continued...

(d) Obtain the hexadecimal equivalent of the following Ethernet address.

00111010 00010001 01010101 00011000 10101010 00001011

[3 marks]

Continued...

Question 3 (25 marks)

(a) The Internet Protocol (IP) is an important network layer protocol that enables host-to-host delivery and routing.

(i) Is IP a reliable or unreliable protocol? Justify your answer. [2 marks]

(ii) Simplify IPv6 address 2041:0000:140F:0000:0000:0000:875B:131B [2 marks]

(iii) What are the strategies to transition from IPv4 network to IPv6 network? [3 marks]

(b) A classless IP address is given as 11.11.11.84/26.

(i) How many host addresses are available in the network? [1 mark]

(ii) Determine the first address in the subnetwork. Show your working. [2 marks]

(iii) Determine the last address in the network. Show your working. [2 marks]

(c) A company is assigned the IP addresses of 100.100.100.0/24. Design an IP addressing scheme with subnetting that can accommodate 6 subnets with 14 usable hosts in each subnet.

(i) Determine the number of bits that must be borrowed from the Host ID to accommodate the 6 subnets. [1 mark]

(ii) What is the number of bits that must be reserved to accommodate the 14 hosts? [1 mark]

(iii) What is the subnet mask used? [2 marks]

(d) Tezla organization has 3 locations, A, B and C, and it is connected to each other via MPLS network. Tezla is granted a block of IP address (200.100.100.0/24). Tezla needs to have 3 subblocks of IP addresses to use in its 3 (three) subnets: one subblock for 120 IP addresses for A, one subblock for 60 IP addresses for B and one subblock of 10 IP addresses for C.

(i) If location A is allocated the IP addresses (200.100.100.0/25), how many maximum hosts can A platform be assigned? What is the first and the last IP address in this block? Justify your answer. [3 marks]

(ii) Design the subblock of IP addresses for B and its subnet mask? Justify your answer. [3 marks]

(iii) Design the subblock of IP addresses for C and its subnet mask? Justify your answer. [3 marks]

Continued...

Question 4 (25 marks)

(a) Assume a Transmission Control Protocol (TCP) client expects to receive byte 5050, but it receives a segment with sequence number 5005. What is the reaction of the TCP client to this event? Explain the reason. [5 marks]

(b) (i) Describe why an application developer may choose to run its application over User Datagram Protocol (UDP) rather than Transport Control Protocol (TCP). [3 marks]

(ii) Explain why voice and video traffic is often sent over TCP rather than UDP over internet (*hint: about security)* [2 marks]

(iii) Suppose four TCP connections are present over some bottleneck link of rate R bps. The connections have a huge file to send (in the same direction over the bottleneck link). The transmissions of the files start at the same time. What is the transmission rate that TCP would like to give to each of the connections? [2 marks]

(c) Assume we need to design a Selective-Repeat sliding-window protocol for a network in which the bandwidth is 1 Gbps and the average distance between the sender and receiver is 5000 km. Assume the average packet size is 50000 bits and the propagation speed in the media is 2×10^8 m. Find the maximum size of the Send and Receive windows, the number of bits in the sequence number field (m), and an appropriate time-out value for the timer. [6 marks]

(d) Figure Q4(d) shows a dump of a TCP header in hexadecimal format:

06780AF0 00001B53 00000000 500203DF 00000000

Figure Q4(d)

Answer the following questions:

(i) What is the source port number in decimal? [1 mark]

(ii) What is the destination port number in decimal? [1 mark]

(iii) What is the acknowledgement number in decimal? [1 mark]

(iv) What is the sequence number in decimal? [1 mark]

(v) What is the length of the header in decimal? [1 mark]

(vi) What is the type of the segment? [1 mark]

(vii) What is the window size in decimal? [1 mark]

End of Paper